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ABSTRACT

Research from 1955 to 1960 was reviewed regarding class size, general methods of teaching, problem-oriented approaches to teaching, and directed learning. The examination of effectiveness of teaching suggests: (1) that the critical factor is not class size as such, but the nature of the teaching as it effects learning; (2) that there is little likelihood of discovering a general method that is clearly more effective than others; (3) that problem-oriented approaches to learning are effective, or that inquiry by students and teachers is a promising academic way of life that should be studied for its pedagogical and curricular implications; and (4) that directed learning, which is the essence of the teacher's role in inquiry, is effective teaching. (Author/LBH)

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NEW DIMENSIONS in Higher Education

Number 2

Effectiveness in Teaching

U S DEPARTMENT OF HEALTH EDUCATION & WELFARE NATIONAL INSTITUTE OF EDUCATION

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Highlights

1. Inasmuch as the dearth of good teachers is becoming more acute with rising enrollments, it is prudent to examine ways and means of making good teaching go further.
2. The new research on effectiveness of teaching suggests:
   a. That the critical factor is not class size as such, that it is rather the nature of the teaching as it affects learning.
   b. That there is little likelihood of discovering some one general method that is clearly more effective than others.
   c. That problem-oriented approaches to learning are effective; that inquiry by students and teachers is a promising academic way of life that should be examined for its pedagogical and curricular implications.
   d. That directing learning, which is the essence of the teacher's role in inquiry, is effective teaching.

OE-50006

NEW DIMENSIONS in Higher Education

Number 2

Effectiveness in Teaching

by
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Clearinghouse of Studies on Higher Education
Division of Higher Education

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
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FOREWORD

This is the second study to appear in the series "New Dimensions in Higher Education." It deals with recent research on teaching effectiveness and thus bears upon the critical problem of faculty utilization. It has been prepared by the staff of the Clearinghouse of Studies on Higher Education.

The data reported in this paper come from two of the categories employed in the Clearinghouse of Studies on Higher Education: "Teaching" and "Curriculum." The research reviewed is that done since 1955 on class size, "general" methods of teaching, "problem-oriented" approaches to teaching, and "directed" learning. Hypotheses are advanced on the four areas of research identified above, and data bearing upon these hypotheses are quoted subject by subject and study by study.

Colleges and universities are interested in making their teaching as effective as possible. This review attempts to alert institutions to studies, most of which have yet to be published and hence do not appear in any bibliography except that represented by REPORTER. We hope this review will be helpful to institutions doing or contemplating research on teaching.

Homer D. Babbidge, Jr.
Assistant Commissioner
for Higher Education

Harold A. Haswell
Director, Higher Education
Programs Branch

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I. INTRODUCTION

ALWAYS IMPORTANT, teaching effectiveness is today a national concern. In the second report of the President's Committee on Education Beyond the High School the top priority is given to "the mounting shortage of excellent teachers."[1] Since the most strenuous efforts in the recruitment and training of college teachers can hardly meet the requirements of higher education in the foreseeable future, the most practicable way to provide enough good teachers is to make good teaching go farther. The President's Committee recommends that "educational organizations ... keep individual colleges fully informed about such experiments and new developments"[2] as look in this direction. The Clearinghouse of Studies on Higher Education cannot be sure that the research reported to it is representative of the work done; nevertheless it is sharing the information it has on teaching effectiveness. Irrespective of the degree of completeness of the sample, it has been drawn objectively for it includes all of the newer studies even though some are not "experimental" in nature. While one 1954 and one 1955 study are reported, the rest (31 studies) are of research done during the last three years (1956-1958). Not included is the research on television because this has been reviewed carefully in "Teaching by Television," a report from the Ford Foundation and the Fund for the Advancement of Education, May 1957.

The aim of the present reporting is:

1. To state the hypothesis suggested by the data in each of the four categories into which this research falls, (a) class size, (b) "general teaching" methods, (c) "problem-oriented" approaches to teaching and (d) "directed" vs. "undirected" teaching;
2. To summarize the research done and to suggest some of the implications seen;
3. To review the several studies, describing, in each instance:
   (a) the conditions under which the study was done--this very briefly--and -
   (b) the findings in representative quotations;

[1] Second Report to the President, The President's Committee on Education Beyond the High School. Washington: U.S. Government Printing Office, July 1957, p. 5.

[2] Ibid., chap. 1, "The Need for Teachers," p. 18.

4. To note at the end of each category the implications in the several experiments for independent study.[3] In this connection it should be recalled that the President's Committee on Education Beyond the High School recommended "that there be vigorous and objective exploration and application by faculties and administrators of methods of increasing the effectiveness and productiveness of the teacher, including instructional procedures which place on the student more responsibility for self education ...."[4]

The research is presented in this manner so that the reader can quickly see the historical and other contexts of the work and the direction it has taken. By taking exception to the hypotheses as stated or the data as presented and selected for quotation, the reader can advance this research and the understanding of it. It is also hoped that this technique of presentation will cause the reader to supply data (i.e. studies) not as yet reported to the Clearinghouse and so help to develop better working hypotheses. If the reader wants more information about any study described he should write the author, whose campus or other present address is given, or consult the Clearinghouse.

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[3] For definition of independent study, see The Independent Study Program in the United States, by Robert H. Bonthius et al, New York: Columbia University Press, 1957, p. 9.

[4] Op. cit., p. 18.

II. CLASS SIZE

Hypothesis A: That class size is not the critical variable in teaching effectiveness in higher education; but rather the quality of the teaching (and learning).

The evidence in support of hypothesis A, as Macruder and others observe, has been piling up for four decades or longer. The criticism leveled at earlier studies, that they only measured the content of learning, has lost much of its force because reasonably valid tests of intellectual skills, of motivation and attitudes have been devised and used in the newer research. The hypothesis stated above seems to be an accurate representation of the facts, for all the 12 papers in this section point in this direction as do most of the earlier studies. It is also properly qualified; this is not the case with most statements on this subject. Since something other than size, namely the quality of the teaching (and learning), is the critical factor at least in higher education, it would seem that this is where we should look to discover how greater teaching effectiveness may be achieved.

In the studies examined, and described on pages 3-9, 12 deal with class size. The research (including in each instance the conditions under which it was done and its findings) used as the basis for the hypothesis developed above, is as follows:

1. "Experimental Study in Instructional Procedures," F. G. Macomber and Lawrence Siegel, Miami University, 1957 (also "Progress Report, Experimental Study in Instructional Procedures," 1956).

Courses in introductory business and government (81 students), chemistry (134 and 92), classics (49), composition and literature (138 and 99), economics (90 and 157), French (31), geography (296 and 207), government (39), mathematics (77 and 42), physics (73 and 93), psychology (88 and 56), sociology (58), social studies (50 and 30), teaching principles (45), and zoology (135 and 102). Classes were met in large sections (296-31) and in small sections (averaging 25-30 but dropping as low as 16).

Findings

"Acquisition of subject matter knowledge is not adversely affected by assignment to a large class rather than to a small control section. This has been a consistent finding for all three semesters of investigation to date."

"When ... achievement, defined as the ability to solve problems and think critically in the subject-area ... was investigated

... in selected courses ... it was found that large class instruction compared favorably with control instruction."

"In terms of the development of desired attitudes [or overcoming of stereotypes] within the field of study [evaluated only in three courses] ... large class instruction was found to be somewhat inferior in this regard in two of the three courses."

"Student motivation and interest in the specific subject matter is not significantly diminished in large classes for one semester."

"Most students enrolled in ... large classes would prefer to be in a conventional [smaller] class ... The instructor is a major determinant."

"The progressive disenchantment [found in] TV instruction ... was not characteristic of students in large classes (that did not employ television)."

"Attitudes about ... large class instruction are independent of student's level of academic ability."

"The ... students' attitudes toward the method of instruction did not influence achievement in any of the courses."

"The students' attitudes toward large classes appear to be influenced [not by size] but by the content of the course and the ability of individual instructors to handle larger groups of students."

"Preparation time for large classes is not disproportionately lengthy as it is for TV classes, and ... the physical barrier between student and teacher is not as severe."

"Teaching a large class other than through television is more demanding than teaching a small class .... The amount of time necessary to develop cases and problems ... is much greater than the time required to handle the course by lecture."

2. "Class-Size and Teaching Efficiency," Joseph C. McKenna, Fordham University, 1957.

Courses in introductory social science (economics, politics, and sociology): Classes were met in larger (60 students) and in smaller (30) sections.

Findings

"Given good teaching, a large class with good quality equaled the achievement of a smaller class with the same quality [in] command of subject matter, social awareness and in principled synthesis of social outlook."

"The opportunities provided for instruction and questions seemed as satisfactory to the members of the large classes as of the small."

3. "Large and Small Sections in College Classes," J. H. Rohrer, Tulane University, Journal of Higher Education, Vol. 28, 1957, pp. 275-79.

Introductory course in American government: Classes were met in large (332 and 309 students) and small (31 and 23) sections. The same coverage, assignments, textbook, syllabus, and examinations were involved in both types of classes.

Findings

"The amount of achievement, as measured by standardized tests [and] the attitudes of students toward American Government, varied as a function of the course instructor and did not vary as a function of size of class. This suggests that the differential skills and abilities of the instructors to present materials to large and to small classes is the critical variable."

4. "Experiments in Teaching Effectiveness," Vernon Davies, Edward Gross, and James F. Short, Jr., Washington State University, 1958.

Course in introductory sociology: Classes were met in large (71 students), in medium (35), and in small sections (18).

Findings

"Size of class was not found to be related to student achievement."

5. "General Report on the Program for the More Effective Utilization of Teaching Resources," University of New Mexico, September 1, 1957.

Courses in accounting (192 vs. 30 students and 62 vs. 28), English (47 vs. 11-26), American government (60 vs. 28 vs. 14), algebra (56 vs. 6 small sections of 19 to 29): Classes utilizing lecture or discussion or combination of both were met in large and in small sections, the sizes varying with the subject and level of advancement.

Findings

"Where class sections were determined to have been comparable ... results ... suggest that the instructor is a more important variable than class size per se. For example, ... where the same instructor taught sections of three sizes, the performances of the sections nearly coincided ...; where the same instructor taught a large and small section, there were no significant differences in performance, although the mean score of

the large section was in each case slightly lower. Further, where multiple small sections were taught by different instructors ... significantly different performances resulted."

"The difference in size and sectioning of [the] accounting [class] did not in itself lead to a demonstrable difference in outcome [as measured by a final examination]."

"The generally insignificant differences allow us to regard ... two sections [of accounting, one large and one small] as equivalent in the outcomes measured. The higher proportion of B's in the small section, while statistically significant, is mitigated somewhat by the consistently neutral findings for the other letter grades and the numerical scores."

"... the performance of the large section was slightly below the central tendency of ... [five smaller] sections taken as a group. The extent to which this is attributable to the difference in size or to grading and other possible differences among the instructors, cannot be ascertained." (English.)

"Class size was not differentially related to performance in the course, the utilization of class time, nor attitudinal changes." (American government.)

"The large experimental section was, from the standpoint of ... [a college algebra course], neither superior nor inferior in performance."

6. "A Lecture-Study Mathematics Program," James C. Eaves, University of Kentucky, 1958.

Courses in mathematics: Classes were met in large lectures (180) and in smaller lectures (25). (Provision was also made for supervised study in connection with the large lectures.)

Findings

"It was possible to assign the most competent faculty [to the large classes]."

"Impressionistic reports are favorable both as to the quality of the instruction and as to the effectiveness of student-faculty contacts. Students and their parents ... were enthusiastic."

7. "Preliminary Report on (Mathematics) M 101-2 Study, 1956-57, On Use of Student Assistants," Ruth Churchill and Paula John, Antioch College.

Course in the fundamentals of mathematics (a general education course): Classes were met in large lectures (70) and in smaller discussion sections (20-30). (Students in the large lectures met in small, 35-student laboratories supervised by upperclassmen. Students in the small discussion sections met in 20 to 30-student laboratories conducted by the instructor.)

Findings

"The skills and content [learned] ... did not differ significantly [in] the two types of classes."

8. "A Study of Student Achievement as Affected by Teaching Method and Class Size," Roland H. Trathen, Rensselaer Polytechnic Institute, 1957.

Course in statics and strength of materials: Classes were met in large lecture and problem or experimental sections (85) and in small lecture discussion sections (16-20).

Findings

"The students in the experimental sections received better grades on the final examination."

"The student has not suffered because of his assignment to a large experimental group. It also appears that a case can be made for exposing students, in large groups, to the most capable, sensitive and stimulating teaching that a school can afford."

9. "Toward More Effective Teaching at Rensselaer," No. 4, December 1958.

Courses in chemical engineering (64 and 65 students), engineering mathematics (65), metallurgical engineering (larger than usual 20-man section), psychology (50 vs. 25): Classes were met in large and in small groups (actual size depending on specific subjects).

Findings

"Seniors consistently perform as well in large single sections as ... in traditional small sections .... When juniors are taught by a combination of large lectures and small discussion groups, their achievement is comparable to that attained under the small section system." (Chemical engineering.)

"Course grades indicated that the level of achievement of the large sections was at least as high as that attained by the small sections ... [Other factors] contributed to the success of the large sections .... More questions were asked after large class sessions than ... small sections." (Engineering mathematics.)

"Student achievement in the larger classes appeared to be equal or superior to that of comparable students in smaller classes of previous years." (Metallurgical engineering.)

"Preliminary comparison of student performance in this [large] section with that in smaller sections ... failed to reveal any significant discrepancies .... This increase in class size was accompanied by some improvement in the quality and pertinence of classroom discussion without adverse effect on the amount of discussion." (Psychology.)

10. "Teaching By the Discussion Method," Samuel L. Becker, James N. Murray, Jr., and Harold P. Bechtoldt, State University of Iowa, 1958.

Course in American government: Classes were met in large (75-80) and in small sections (18-25).

Findings

"It appeared as feasible to conduct a class by the discussion method with 75-80 students ... as with 18-25 students."

11. "Experimentation With Implications for Instruction," a summary, Tom A. Lamke, Iowa State Teachers College, 1958.

Courses in business education, education, humanities, mathematics, piano and speech: Except for one course providing individual instruction classes, which usually met in several small sections, met in a single section twice to several times as large.

Findings

"Incomplete; some evidence that instructional efficiency can be improved through scheduling multi-section classes to meet together once a week and in separate sections remainder of week." (Business education.)

"Using two instructors, each teaching in his specialty, 116 students taught in one section instead of the usual 48. Instructional outcomes seemed satisfactory." (Education.)

"Incomplete, but some evidence suggests class size may be increased to 48 instead of the usual 18-20, with improved learning." (Speech.)

"Evidence indicates that students learn as much in classes of 80-100 as they previously did in classes of 35 or less." (Mathematics.)

"Use of group instruction [and student assistants] in teaching beginning piano seems effective."

"Instructional outcomes in a class of 70 seemed no better than those in the usual class of 40-50. If we ... have not made a good case for the small class, we certainly have not made one for the large class either." (Humanities.)

"Students in a class of 48 did not do quite as well as students in a standard sized class of 28." (Education.)

12. "The 'Dialog'," Winslow R. Hatch, Washington State University. Improving College and University Teaching, Summer 1958, pp. 73-82.

Discussion-type meeting, called a conference, in a science course. Classes met in small (16-20) and medium (35-40) sections.

Findings

Students think their way through to their own answers.

"The questions raised and the statements made in answer to them are usually short, so that the discussion is smartly paced."

"There are often ten to fifteen auditors at a dialog."

Implications for Independent Study

The size of classes is an entirely irrelevant matter so far as independent study is concerned. A small class does not advance independent study, or even learning, because it is small or a large class inhibit such study because it is large. Both could. The critical element for independent study in particular and learning in general is what goes on in the class. Are the individual students thinking or are they being caused to think? The implication in Hypothesis A for independent study in higher education is that the teaching (and learning) is the critical factor--a kind of teaching that can make large class meetings (usually lectures) acceptable, if not ideal, instruments for stimulating independent study.

Some experimentation has already been done in a few honors or independent study programs with large class meetings. More will probably be done out of necessity or conviction. The implications for discussion or group conferences are also clear for there is no evidence in the research reported that somewhat larger sections than those characteristically employed today cannot be made effective instruments of independent study. This follows because, as is observed in "Teaching by the Discussion Method," "It is a well-known fact that no single student is able to participate very often in a classroom discussion. In other words, much of the discussion experience is actually vicarious." At Washington State University large sections (40-60) were surprisingly successful in an independent study experiment.

III. GENERAL OR PEDAGOGICAL METHODS

Hypothesis B: That as regards the "general methods"[1] of teaching, no one method can be demonstrated to produce more or better learning than another.

If the research reported below is representative of our present state of knowledge we should abandon the hope--and the research nourished by this hope--that a miracle can be worked by discovering and employing some one "general method" of instruction. We would be better advised to direct our energies in more profitable directions.

Stated somewhat more concretely, the consensus of studies made since 1920 is that no one mechanical teaching device, in and of itself, is better than another. Teaching by the lecture, recitation, discussion, tutorial, reading-study, reading-quiz, correspondence or several different laboratory methods (the regular, the drawing, or the physiological type) has not been demonstrated to be intrinsically better than some other technique. The object of research on effectiveness of teaching should be shifted from the "tactics" of teaching to the "logistics" of learning, to methods which, in contradistinction to the pedagogical, may be described as the methods of scholarship, of inquiry, of problem-solving or of critical thinking.

In the studies examined and described on page , 8 deal with "general" methods of teaching. The research (including in each instance, the conditions under which it was done and its findings) used as the basis for the hypothesis developed above, is as follows:

1. "Effects of Varying Degrees of Student Interaction and Student Teacher Contact in College Courses," T. S. Parsons, W. A. Ketcham, and L. R. Beach, Instructional Efficiency Research Program, Project II, University of Michigan, 1958, pp. 1-56.

The experimental treatments consisted of:

(a) Conventional classroom: (lecture)
(b) Conventional classroom: (small group discussion)

[1] "An Experimental Comparison of Recitation, Discussion, and Tutorial Methods in College Teaching," Harold Guetzkow, Carnegie Institute of Technology, E. Lowell Kelly and W. J. McKeachie, University of Michigan. The Journal of Educational Psychology, Vol. 45, April 1954, pp. 193-207.

(c) Autonomous instructorless small groups meeting at student's discretion
(d) Instructorless students engaged in independent study, with no student contacts, and no assignments.

This study involved 98 students in a course in psychology of child development, and 61 students in a sociology course, marriage.

Findings

"The 'no interaction,' 'no teacher contact' independent students ranked highest, the 'high interaction,' 'no teacher contact' autonomous groups were in the middle, and the 'medium interaction,' 'high teacher contact,' discussion classroom averaged lowest" in on-campus, weekday meetings. "The lecture classroom and autonomous groups . . . averaged nearly the same on achievement while the independent students . . . scored below them 'significantly' [in Saturday or off-campus meetings]."

"Four months after [the course] . . . no statistically significant differences in achievement . . . remained among any weekday experimental groups."

"In the Saturday section . . . total differences in measured achievement became even greater . . . between the high scoring lecture classroom . . . and the low scoring independent student."

"When students' characteristics, such as 'residential status' and 'professional experience' were examined, it was discovered that these were more important determiners of these outcome variables than the methods alone."

"Situational and demographic characteristics of students are probably more important factors in determining . . . learning than are even large variations in the instructional method."

2. "The Relationship of Teaching Effectiveness to Class Size and Method of Instruction," Vernon Davies, Edward Gross, and J. F. Short, Jr., Washington State University 1957.

Size was kept constant and three methods, the lecture, the use of visual aides, and closed circuit TV were compared.

Findings

"Teaching technique was not found to be related to student achievement."

3. "Teaching by the Discussion Method," Samuel L. Becker, James N. Murray, Jr., and Harold P. Bechtoldt, State University of Iowa, 1958.

Experimentation was done with television discussion (14-35), and television observation (27-24), small group discussion (18-29),

large group discussion (75), and the lecture method (112-132), in a basic course in American government.

Findings

". . . As measured by the mid-term and final examinations . . . it made no difference which method was used."

"Students of high and low ability were not differentially affected by the method of instruction."

As regards "attitudes toward the concepts of 'liberal democracy' . . . there was no significant difference between methods of instruction."

"The only advantage of discussion over lecture appeared to be that students tended to prefer the discussion method. The instructors, on the other hand, preferred relatively more lecturing."

"If the method of instruction made the slightest difference, this difference was dwarfed by the general academic ability factor."

4. "A Comparison of Instruction by Kinescope, Correspondence Study and Customary Classroom Procedures," Thomas S. Parsons, University of Michigan, The Journal of Educational Psychology, Vol. 48, No. 1, January 1957, pp. 27-40.

Findings

"Kinescope or T.V. techniques are at least as effective as--and independent correspondence study is probably more effective than--conventional class discussion methods for promoting durable factual achievement, alone, in abstract or highly verbal academic subjects."

"No significant difference appeared . . . in achievement, cohesiveness, and ratings of the course's personal value."

5. "A Study of Student Achievement as Affected by Teaching Method and Class Size," Roland H. Trathen, Rensselaer Polytechnic Institute, 1957.

Two methods were used. Either two large lectures (85-98) and 2 problem sessions replaced 4 meetings of small sections (17-23 or less), or the original number of lectures (70 students) and discussions (16 students) was held, but one instructor replaced several, the students were asked to assume more responsibility, and questions and problems were introduced.

Findings

"Students in the experimental section [large lecture and problem sessions] received a better score on the final examination. . . . It further showed that the very capable student . . . does well irrespective of the method of instruction. The average student, however, shows a better performance in the experimental section." Furthermore, "the capable student does well irrespective of the individual instructor to whom he is assigned. The average student's performance, however, depends in large measure on the instructor."

6. "Large and Small Sections in College Classes," John H. Rohrer, Tulane University, Journal of Higher Education, Vol. 28, 1957, pp. 275-79.

Findings

"No statistically significant differences were observed between the small class between 23 and 31 . . . taught by the lecture or discussion methods, but differences were revealed in the achievement of students where taught by different instructors."

7. "A Comparison of Two Techniques of Laboratory Instruction (Chemistry)," Bureau of Industrial Testing and Institutional Research, The University of Omaha, fall 1956-57.

Comparison was made of the value of the conventional laboratory training in the introductory chemistry course with a lecture demonstration method of laboratory training.

Findings

"The laboratory-demonstration method is not significantly different from the individual laboratory method of teaching first semester college chemistry."

8. "An Experimental Study of Laboratory Teaching Methods in General Zoology," Hubert Frings, and Joseph K. Hichar, Pennsylvania State University. Science Education, Vol. 42, April 1958, pp. 255-62.

Three laboratory teaching methods were compared:

(a) The regular--using a manual in which the identification and knowledge of structures, and their functions, is described and illustrated by labeled diagrams;

(b) The drawing--unlabeled drawings used;

(c) The physiological type--living specimens used, with experiments, experiment sheets, questions.

Findings

". . . none of the three laboratory teaching methods tested . . . is better than the other(s)."

Implications for Independent Study

The implication in this research for independent study is that general or pedagogical methods, in and of themselves, neither advance nor hinder independent study. Here, as with class size, it depends upon what is done with the methods. If some traditional method is used--and it may have to be--in order to be successful it will have to involve students in their own inquiries. The vehicle may have to be a large lecture class but it will also have to contrive to send individual students on intellectual errands. These errands may take the students off in as many directions as there are students. What is better, the students may be asked to address themselves to and resolve the same problem but always one big enough to instruct them in a substantial body of fact and ideas. To state the matter somewhat differently, so that there can be no misunderstanding of a matter about which there is much misunderstanding--the adoption of independent study as an academic way of life does not mean that the teacher has to abandon teaching devices to which he has become accustomed and in which he may have much expertness. It means, rather, that he should examine the uses to which the device is put and the degree to which he can get his students to extend his as well as their reach.

IV. PROBLEM-ORIENTED METHODS OR METHODS OF INQUIRY

Hypothesis C: That "problem-oriented"[1] approaches to teaching improve learning.

The research reported below supplies the first positive evidence of how teaching effectiveness can be increased by employing the methods of scholarship or of student inquiry. Whether these methods are aptly described as "problem-oriented," problem-solving," or case study, or simply involve "critical" thinking, is not important; at least it is no more important than any one of these phrases might be in describing the research done by a faculty. The important thing is that in his learning, and in the teaching that accompanies it, the student should inquire into, rather than be instructed in a subject matter.

When teaching and learning are made forms of inquiry and a commitment is made to the principle both the teacher and the student apparently still need help with the specifics: How does one ask questions? What is an effective pattern of progression in questioning? While these problems have been identified and the demands of specificity have been recognized to the extent of producing transcripts of the questioning done in lectures, laboratories, and conferences, and of assembling copies of the examinations,[2] this experimentation has not been evaluated in any objective fashion.

When, added to the findings of the 12 studies reported here, one takes into account the literature on critical thinking[3] and particularly the newer research on creativity, authoritarianism[4] and the impact of teaching on student attitudes and values,[5] independent study begins to receive impressive support--experimental

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[1] This includes case, and inductive-deductive methods, "teaching for the development of thinking" and of creativity.

[2] "The Socratic Method in Modern Dress," "The Lecture," "The Laboratory," "The 'Dialog'," and "The Examination," Winslow R. Hatch, Improving College and University Teaching, summer 1957-autumn 1958. Dr. Hatch's present address is: Office of Education, Washington 25, D.C.

[3] General Education: Explorations in Evaluation; The Final Report, by Paul L. Dressel, Washington, D.C.: American Council on Education, 1954.

[4] Paul Heist and T. R. McConnell, Center for the Study of Higher Education, University of California, Berkeley 4, California.

[5] "Impact of a Woman's College on Its Students," by Nevitt Sanford, Vassar College, 1957.

"The Motivation of Women for Education: The High Achievers," by Nevitt Sanford, Vassar College, 1957.

"The Passage Through College," by Mervin Freedman, The Journal of Social Issues, Vol. XII, No. 4, 1956, pp. 13-28.

"Personality Development During the College Years," by Nevitt Sanford, The Journal of Social Issues, Vol. XII, No. 4, 1956, pp. 1-70.

support. Then too, surveys made of "flexibility"[6] and brilliantly intuitive "think" pieces[7] also suggest an association between independent study and the quality of teaching and learning, or the quality of instructors and students, hence of institutions.

Not considered here is the notable success enjoyed by some institutions with case or conference methods and colloquia. Finally, as has been noted, problem-oriented courses, or projects have been made an integral part of independent study or honors programs.

The need for "reinforcement" has also been identified[8] as one of the problems in this kind of teaching. To realize their full potentialities, problem-oriented approaches have to be made in course after course, and, ideally, in an entire program of study. The relationship between inquiry and "creativity" has not been established in any precise way, but the first would seemingly enhance the second.

In the studies examined, and described on pages 16-23, 12 dealt with "problem-oriented" approaches to teaching. The research (including, in each instance, the conditions under which it was done and its findings) used as the basis for the hypothesis developed above, is as follows:

1. "The Problem-Oriented Approach to Teaching Psychology," W. J. McKeachie and Wesley Hiler, University of Michigan. The Journal of Educational Psychology, Vol. 45; No. 4, April 1954, pp. 224-32.

Findings

"A problem-oriented method" which made use of work sheets, designed for introductory courses and tested out in an elementary psychology course, proved "highly" effective in that the students employing this method made 42% fewer errors than the control group.

2. "An Experimental Comparison of a Conventional and a Project Centered Method of Teaching a College General Botany Course," Joseph D. Novak. The Journal of Experimental Education, Vol. XXVI, No. 3, March 1958, pp. 217-30.

Comparison was made between the conventional teaching method employed at a large State university and an approach that

[6] "Flexibility in the Undergraduate Curriculum," by Charles C. Cole, Jr., Lafayette College, 1958.

[7] "Generation of Greatness--The Idea of a University in the Age of Science," the Ninth Annual Arthur Dehon Little Memorial Lecture, Massachusetts Institute of Technology, Edward W. Land, Cambridge, Massachusetts, May 22, 1957.

[8] "Teaching for the Development of Thinking Abilities and Habits," 1957, Hope College; "An Exploration in the Teaching of Critical Thinking in General Psychology," 1957, Greenville College.

centered on more rapid presentation of material, and a 6-week period devoted to project work.

Findings

"The project-centered method was found to be at least as effective as the conventional method in teaching botanical facts and principles, though the rate of presentation was more rapid."

3. "Lectures Versus Problem Solving in Teaching Elementary Soil Science," Murray D. Dawson, Oregon State College. Science Education, Vol. 40, December 1956, pp. 395-404.

This experiment was conducted at Cornell University in a beginning soil course (Agronomy 1) with an enrollment of 140 students.

Findings

"The . . . mean gains obtained on recall of specific information . . . [were] almost identical" for students in the two groups. This confirms Weissmann's[9] and Darrell's[10] findings that the problem-solving students "made as great or greater gains in learning facts and principles," and that there was "no significant difference" in factual recall between students exposed to lectures and problem-solving situations.

"In all the recognized steps of problem solving, the students in the problem-solving groups were consistently higher than those in the lecture method recitations."

4. "A Graphics Course for Science Majors," Eugene Paré, Illinois Institute of Technology. Journal of Engineering Education, Vol. 46, No. 9, May 1956, pp. 798-801.

In a new "basic drawing course for students majoring in chemistry, mathematics, and physics . . . the student was introduced to topics through the medium of problems. . . . About forty per cent of the laboratory time was devoted to . . . problem solving." Some problems were solved by the entire class as part of a blackboard presentation. Others were separate problems distributed according to student abilities with the solutions discussed on completion. The student was also "encouraged to

[9] "Some Factors Related to the Ability to Interpret Data in Biological Science," Leah Lena Weissman, Doctoral Dissertation, University of Chicago, 1946.

[10] "The Lecture-Demonstration versus the Problem-Solving Method of Teaching a College-Science Course," Bernard J. Darrell, New York University. Science Education, Vol. 26, No. 3, 1942.

experiment with original patterns of his own" and more concern was shown "with the student's ability to visualize than with his drafting proficiency." Finally, "the student is confronted with an original design project of his own."

Findings

"The course has been an interesting one to teach. Apparently it has been equally stimulating to the student; after completing the course, three of our current science majors transferred to our teacher training program in drawing."

The teaching methods employed "helped to conserve time and improve presentation."

By recognizing individual differences in problem solving, "the skill in visualization of the slower student developed, and at the same time the more adept student was presented with more challenging material."

5. "Thought Stimulation by Demonstration Experiments," Hosmer W. Stone, University of California. Journal of Chemical Education, Vol. 35, No. 7, July 1958, pp. 349-51.

The method used is that of asking questions and seeking the answers by means of experiments.

Findings

"Both students and teaching assistants seemed to have responded to the thought stimulation of the demonstration, and perhaps some who had been only enrollees belonging to class 1 ('those who are content to memorize the material of the course for the purpose of regurgitation during examinations') had an inkling of how the students of class 3 ("those who . . . use . . . original thought processes") were proceeding to obtain an education in chemistry.

". . . the technique of thought-provoking questions and experimental answers can be used to stimulate original thinking in a chemistry class. Many students found pleasure in these questions and experimental answers who would otherwise have been content with the minimum of thinking involved in the 'tried and true' memory system with which they entered the course."

6. " 'Case Studies' Increase Interest in Materials Laboratory," P. F. Brandenburg, University of Wichita. Journal of Engineering Education, Vol. 46, No. 7, 1956, pp. 563-64.

"The class was first divided into two groups, and problems rather than experiments were assigned to each group. Instead of

reports, the students in group A were required to write a procedure to be followed by group B. The problems were composed in a fashion to interest the students in determining why the test was necessary and what results were needed to solve the problem properly." Each problem was planned to familiarize the student with a different phase of testing so the scope of the course would not be changed and the student would get his basic background knowledge through individual problems.

Findings

"The above plan has been in operation for two years, and has been a source of satisfaction to all concerned. . . . The students now ask questions that show interest and comprehension of test methods . . . Finally, the approach used here, . . . need not be confined to testing, but can be used with equal success in many other laboratory courses."

7. "The Inductive-Deductive Method and the Physical Science Laboratory," Arnold M. Lahti, Western Washington College of Education. Journal of Experimental Education, Vol. 24, No. 3, March 1956, pp. 149-63.

At the University of Minnesota in classes numbering 338 and 395 students, Lahti experimented with four methods "to see which was most effective" in developing the student's ability to use the scientific method. These methods were:

(a) The inductive-deductive or problem-solving method.

(b) The historical or research method; actually a modification of Conant's Case Study approach.

(c) The theme method in Study One, the discussion method in Study Two.

(d) Standard, descriptive or "cookbook" method.

The experimentation was done in the laboratory only, the professor working with students individually or in small groups.

Findings

The "observational data indicated that the mean scores of the inductive-deductive method were higher on all parts of all tests in Study One. . . . On the Interpretation of Data Test . . . the historical and standard methods were a close second . . . the theme method slightly lower. . . . In the Design and Experiment Test the mean scores of the inductive-deductive method appeared to be considerably higher than those of the other three methods. . . . On the Performance Test the mean score of the inductive-deductive method was higher than the mean score of

the standard method." The historical and theme methods followed in this order.

"The same apparent pattern was noticeable in Study Two with one exception. The mean score of the discussion method on the Performance Test was considerably below the mean scores of other methods."

When this data was analyzed for "significance" the author's conclusions were:

"The educational conclusion is that the teaching methods do differ significantly in their effectiveness in developing in the student the ability to use the scientific method."

"The inductive-deductive method was successful in developing problem-solving abilities in subject matter-centered problems."

8. "Teaching for the Development of Thinking Abilities and Habits," John W. Hollenbach, Hope College, 1955.

Findings

Teaching critical thinking requires:

(a) The mastery of the "art of asking questions," which art is often reflected in the teacher's skill with "general problem solving procedures."

(b) The mastery of the "art of discussion--for while effective when used well, discussion often results only in the 'pooling of prejudices,' or it is often a sparring of wits between the instructor and one very vocal student . . . during which time little 'thinking' occurs among the other students."

(c) Full faculty participation. Teaching critical thinking "cannot be the work of any one course. . . . If every course shared the responsibility . . . the overall objective might be realized."

9. "An Exploration in the Teaching of Critical Thinking in General Psychology," Edwin Lyle, Greenville College, 1957.

Procedures "purported to be effective in stimulating thought" were used in a course in general psychology.

Findings

There was no "greater degree of improvement in critical thinking ability as reflected in 'A Test of Critical Thinking, Form G,' in the experimental section as compared with the control section."

Measurable achievement in this area is not likely to come unless students are "taught for critical thinking in all of their classes for (at least) one semester." It seems improbable that instruction in one three-hour course could be expected to produce a degree of improvement which would be reflected in "A Test of Critical Thinking, Form G."

10. "An Experiment in Undergraduate Thinking," Julius Seelye Bixler. AAUP Bulletin, Vol. 43, No. 2, June 1957, pp. 282-87.

An experimental course called "Problems in Creative Thinking" was offered at Colby College for 15 students (not selected because of special ability) by faculty members from the departments of biology, mathematics, history, art, and philosphy. The faculty members attended most sessions but participated only to the extent of setting forth certain facts. The students had to create problems around these facts and solve them.

Findings

The "freshness and . . . experimental quality caught the student's interest."

Students "gained insight into their own intellectual habits . . . [they] were . . . introduced to the difficult art of asking the right questions . . they won a sense of the importance of fact" and learned to develop generalizations based on specific facts. Through a conversational approach they saw "the social nature of thought."

11. "Some Variables Functioning in Productivity and Creativity," Calvin W. Taylor, The Second (1957) University of Utah Research Conference on the Identification of Creative Scientific Talent, pp. 3-19.

The academic history of 239 scientists in a large research center was examined.

Findings

"There is very little statistical evidence . . . to show a significant positive relationship of undergraduate grades to success as a research scientist."

12. "The Effect of Different Learning Methods in Concept Formation," Finley Carpenter, Michigan State University. Science Education, Vol. 4, October 1956, pp. 282-85.

Two types of learning were examined:

(1) Rote memorization--"verbaliz[ing] . . . definitions and . . . memorizing discrete items."

(2) Functional learning--"identify[ing] common characteristics . . . to discover underlying principles that differentiate classes. They observe, manipulate materials, and test hunches in order to formulate an understanding of concepts."

Findings

(a) "Functional learning of concepts, as defined [above] is more efficient than rote learning when measured by retention and ability to verbalize meanings of learned concepts.

(b) "Concepts that refer to classes of material objects are more thoroughly understood when the student has an opportunity to manipulate and study the objects than where only factual information is given by lectures.

(c) "Much . . . fruitful research on teaching methods . . . can be done without [necessarily taking into account] the learner's personality, attitudes, aptitudes, habits in learning and the particular task under an instructor . . ." Complete specificity, as it is sometimes called, is not necessary.

Implications for Independent Study

The results of research on problem solving, critical thinking, creativity and the like are heartening for independent study.

Many of the projects in independent study programs are problem-oriented. The author, with others, of the latest and most comprehensive review of independent study[1] states flatly that problem-oriented study is "a basic method for the independent student."[2] While more objective analysis of its worth may be needed, it is difficult to see how student inquiry, which is the essence of independent study, can be realized unless some critical or scholarly method is employed; not only in the students' projects but in their other learning experiences, be they formal or informal.

The research examined on problem-oriented approaches to teaching supports the thesis advanced by the proponents of independent study. This support comes from a somewhat unexpected quarter, and what is more important, is based upon findings which are the results of rather carefully controlled

[1] The Independent Study Program in the United States, by Robert H. Bonthius, et al. New York: Columbia University Press, 1967.

[2] Letter from J. Garber Drushal, College of Wooster, to W. R. Hatch, August 26, 1959, p. 5.

experiments. The disposition to introduce courses, curricula or practices designed to stimulate and accommodate independent study, is based upon feeling on the part of teachers, derived from many years of teaching unsatisfactorily, so far as they are concerned. To the extent they know their students' minds they are also of the opinion that student learning, and hence their teaching, leaves something to be desired.

V. DIRECTED VS. UNDIRECTED LEARNING

Hypothesis D: That "directed" learning is more effective than "undirected" learning.

A good estimate of the research reported here is that: "[In] the development of concepts, and in the related task of guidance of students in problem-solving, the teacher must present clues . . . for the purpose of directing the students to the successful discovery and application of essential discriminations and relationships. While, in the past, there has been some dispute as to the desirability of teacher-direction as contrasted with student self-direction, recent studies indicate . . . that both in the acquisition and transfer of concepts [and in] problem-solving . . . teacher-direction is the most effective procedure."[1]

The phrase "directed learning," as used above, does not connote a kind of teaching in which the teacher develops his and his students' inquiry in ways that challenge and encourage students to think hard and long and to develop their own hypotheses or explanations.

In the studies examined, and described on pages 24-26, four deal with "directed" learning. The research (including, in each instance, the conditions under which it was done and its findings) used as the basis for the hypothesis developed above, is as follows:

1. "The Effect of Three Teaching Methods on Achievement and Motivational Outcomes in a How-to-Study Course," John D. Krumboltz and W. W. Farquhar, Michigan State University. Psychological Monographs, Vol. 71, No. 443, 1957, pp. 1-46.

Three teaching methods were experimentally examined:

(a) Instructor-centered--meaning one which emphasized intellectual interest and employed lectures and other instructor-directed activities.

(b) Student-centered--meaning one which took up student problems and employed student committees and student-led discussions.

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[1] "Experimental Studies of the Teacher's Verbal Behavior in the Development of Concepts," a statement of a research project prepared by Bernard R. Corman and John D. Krumboltz, Michigan State University, December 1, 1958.

(c) Eclectic--meaning a combination of the above but one which employed instructor-led discussions.

Findings

"Students in the eclectic section were most highly motivated . . . the instructor-centered students were second; and the student-centered students showed the least increase. These method differences disappear when males only are analyzed, indicating the major contribution of females to these differences."

"When students are categorized on the basis of their original preference for teaching method, it is found that students who originally expressed a preference for a more cognitive-type instruction increased their self-ratings of study habits and attitudes (SSHA). Students who originally preferred a . . . student-centered type of instruction tended to lower their self-ratings."

"No significant motivational or achievement outcomes are found in relation to ability level . . . there is no tendency for bright students to have any different outcomes under one teaching method than another."

2. "The Effect of Varying Amounts and Kinds of Information as Guidance in Problem-Solving," B. R. Corman, Michigan State University. Psychological Monographs, Vol. 71, No. 431, 1957, pp. 1-21.

Findings

"For students above average in mental ability, success in solving problems increased only . . . as the amount of information given about method increased."

"For students above and below average in mental ability, information about the rule [principle] did not seem to affect results differentially."

"Information used in guidance [in problem solving] must be appropriate to the task . . . some appropriate guidance is beneficial . . . explicit instruction will prove most helpful with the more able students; less explicit instruction may be just as effective for the less able."

3. "Directed Versus Independent Discovery of Established Relations," R. C. Craig, Washington State University. Journal of Educational Psychology, Vol. 47, 1956, pp. 223-54. Dr. Craig's present address is Marquette University, Milwaukee, Wisconsin.

Findings

"The group receiving the greater direction . . . learned more relations in each of three trials."

4. "Systematic Observation of Instructor Behavior," Joseph E. Morsh, Development Report, AFPTRC-TN-56-52, Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, May 1956.

One hundred and twenty instructors in the hydraulics branch of the Aircraft Mechanics Course were observed. "The three criteria of instructor effectiveness used in the . . . study were student ratings, supervisor ratings, and student gains."

Findings

"The student-gains criterion correlated significantly with only one item of instructor behavior [verbal and non-verbal], 'instructor asks question, then designates student.'"

Implications for Independent Study

This research affirms what is obvious if the teacher is to accept the opportunity and the responsibility which are his. For independent study the implications do not seem to be so obvious, for in too many programs the teacher's role is almost casual. Actually, independent study requires greater commitment on the part of the teacher than do traditional methods. He cannot remain a bystander, a disembodied mouthpiece. His best and most sustained thinking is required, along with considerable ingenuity; for his job is to involve students in the study of problems which after much introspection appear very much worth the doing, and require considerable effort. "Directed" does not mean "dominated" but quite the reverse. The direction is that of the scholar who encourages, by example, rigorous inquiry into important matters. That independent study can dispense with the teacher or this kind of teaching is an illusion of those who have had little experience with independent study or honors programs.

VI. RESEARCH NEEDED ON THE TEACHING EFFECTIVENESS IN HIGHER EDUCATION; A SERIES OF WORKING HYPOTHESES

SINCE THE CONSENSUS in the newer research, as in older studies, is that the size of classes is not the critical factor in learning, the thing to do--considering the limited resources available to higher education for research--is to move quickly and vigorously to an examination of the critical factors. As regards the critical factors in teaching effectiveness, namely, the quality of the teaching and learning, the most promising working hypothesis is:

That the methods of scholarship ("problem-oriented" or "problem-solving" methods) increase the effectiveness of teaching, particularly when the teacher accepts a teacher's responsibility for directing learning, providing every opportunity and inducement for the student to accept a larger responsibility for his own education, and holding out always as his and their goal the maximum achievement of which they are both capable, be their ability (his and theirs) great or small, effectively engaged, or only latent.

Some of the implications or subordinate hypotheses in the above which might be examined are:

(a) That graduate study has great relevance to teaching effectiveness.

(b) That in graduate study a preoccupation with pedagogical method or research does not improve teaching effectiveness.

(c) That a distinction should not be made between a teaching and a research degree.

(d) That ceilings should not be set on graduate study, a lower one for prospective elementary and secondary teachers and higher ones for college teachers.

(e) That too early a decision as to the stratum of a student's eventual employment and hence of his degree, is not wise.

(f) That for maximum effectiveness teachers should not be assigned to lower or upper division or graduate instruction.

(g) That the involvement of the teacher in research (and a distinction is made between research and pedantry) has real and salutary implications for the improvement of teaching effectiveness.

(h) That the director of learning be considered as an art requiring appraisal by teacher and student of the effectiveness of the conditions of learning created in relation to their commonly shared goals.

(i) That, in sum, to improve teaching one must improve:
A teacher's scholarship,
A teacher's competence to involve his students in scholarly activities suited to their levels of ability and experience,
A teacher's ability to stimulate, endow, and release the potentiality of each of his students.

The estimate made in the first two paragraphs of this section should not be construed to mean that research on class size and pedagogical method has not been productive. Actually, its findings are more conclusive than most research on higher education and indicate clearly what it is that now needs to be done, namely, to determine through carefully designed research how best to use "scholarly" methods to improve teaching and learning. These methods, variously described as inquiry, research, case, Socratic and problem methods are variously approached. Some teachers are attracted because these methods seem to be based on good educational theory, some because they see practical advantages in them. For others these are the methods most appropriate to the scholar-teacher and good teaching. The informed layman and the administrator have sometimes taken the initiative in introducing these methods.

But the problem is larger than method. It has implications for curricular and extracurricular arrangements and requires a re-examination of the objectives of students, of teachers, and hence of institutions. Were higher education clear as to its ends it would presumably be clearer as to the desirability of its means. While, heretofore, the problem of purpose and performance has been largely a matter of belief, the newer research on student achievement appears to have developed instruments by which some of the intangibles can be measured; and one can determine whether his or the institution's purposes are in part being realized and in what degree.

In testing these hypotheses it is recommended:

(a) That research on teaching effectiveness should be done in larger curricular and administrative contexts than has been the case to date.

(b) Where a faculty or institution can examine but one or two hypotheses, its experimentation should be coordinated with that done on other campuses and theoretically with that done on all campuses.

(c) That since better instruments for measuring the effectiveness of the "learning experience", and hence of teaching, are becoming available, these be used to evaluate this experimentation.

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Reactions

In order that the series NEW DIMENSIONS IN HIGHER EDUCATION may more accurately measure the developments examined and better ascertain the disposition of colleges and universities to experiment, reader reaction is sought. To prompt such a response, in this instance to *Effectiveness in Teaching*, the following questions are raised:

1. As a result of your experience (recent or longstanding)
   a. What is your estimate of the direction research on teaching effectiveness is taking?
   b. What is your reaction to the hypotheses advanced in this paper and particularly to the two positive hypotheses regarding *inquiry* and *directed learning*?
   c. What new research should be examined and what new hypotheses should be explored?
2. What experiments with teaching effectiveness do you contemplate?
3. How can we help?

Kindly address reactions to:

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